

Atmos. Meas. Tech. Discuss., referee comment RC1
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Comment on amt-2021-83

Anonymous Referee #1

Referee comment on "Retrievals of dust-related particle mass and ice-nucleating particle concentration profiles with ground-based polarization lidar and sun photometer over a megacity in central China" by Yun He et al., Atmos. Meas. Tech. Discuss., <https://doi.org/10.5194/amt-2021-83-RC1>, 2021

The authors present a technical study to retrieve conversion factors for the well-established POLIPHON (Polarization Lidar Photometer Networking) method at sites that are not as close to deserts to experience pure dust outbreaks, though, are still affected by mineral dust mixed with anthropogenic pollution aerosol (i.e. mixed dust). The presented method uses column-integrated sun photometer data which would not fulfill the usual criteria for the retrieval of pure dust conversion factors (based on Ångström exponent and AOD). Instead, to additionally confirm the presence of (mixed) dust, ground-based and, for a case study, space-based polarization lidar observations were used together with auxiliary tools like backward trajectories and the GRASP algorithm.

As the authors rightly state, the POLIPHON method is a powerful tool to comparably easy (via remote sensing) assess and potentially quantify dust/aerosol effects on cloud formation and glaciation and therefore, weather and climate. Nevertheless, the method is only as good as its input parameters and various ongoing validation efforts. This study provides a useful although error-prone method to retrieve further needed input parameters (conversion factors) and therefore, can be recommended for publication in AMT after revisions especially focusing on a discussion of these errors/uncertainties.

Comments:

- The usage of the GRASP algorithm does not substantially support the presented method. It could also be omitted or more clearly stated as auxiliary in the single case study.
- The main argumentation in this study, why one could also use cases of mixed dust to

retrieve the POLIPHON dust conversion factors, is that Chen et al. (2018) did not find a significant impact of urban pollution on ice nucleation in the immersion mode. This does not necessarily mean that the optical properties of pollution do not have an impact in the retrieval of the conversion factors. I understand that you took the “most dusty” cases you could find at your site for your retrieval. Nevertheless, I suggest to add a more comprehensive analysis of your sun photometer data by also calculating the conversion factors for continental aerosol at your site as described in Mamouri and Ansmann (2016) (c_{290,c}). This provides the opportunity to compare your “dusty” conversion factors with the continental ones and to discuss the possible effect of the continental aerosol/pollution on your retrieval.

- Similarly, you need to provide uncertainty ranges (standard deviations) for the retrieved conversion factors as in Mamouri and Ansmann (2016). These need to be compared and discussed in detail as well. In addition, you state that your sun photometer has a substandard precision in compared to AERONET. How does this influence your retrievals with respect to the uncertainties?
- Furthermore, it has to be made clearer in the whole manuscript that these parameterizations (DeMott et al. 2010, 2015) are for immersion mode INP, than just the one sentence stating the Ullrich et al. (2017) parameterization is valid for deposition nucleation. This is important as Ullrich et al. (2017) indeed provide a deposition nucleation parameterization also for soot aerosol
- Some textual suggestions in the attached PDF.

Please also note the supplement to this comment:

<https://amt.copernicus.org/preprints/amt-2021-83/amt-2021-83-RC1-supplement.pdf>